

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
<small>Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.</small>				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE		3. REPORT TYPE AND DATES COVERED
				FINAL REPORT 01 Jul 94 - 30 Jun 97
4. TITLE AND SUBTITLE (AASERT94-155) Fabrication and Properties of High-Performance Graded Quantum Structures			5. FUNDING NUMBERS	
			61103D 3484/TS	
6. AUTHOR(S) Professor Gossard				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Materials Department University of California, Santa Barbara Santa Barbara, CA 93106			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) AFOSR/NE 110 Duncan Avenue Suite B115 Bolling AFB DC 20332-8050			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
			F49620-94-1-0377	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) In this reporting period, we have extended this work by creating vertical transport structures to allow for resonant injection into the higher levels of a parabolic quantum well to improve the efficiency and intensity of Terahertz emission. Measurements showed the clear presence of coherence and resonant tunneling behavior for wells as wide as 1000 Å. Then, vertically injected Terahertz emission devices were made with multiple cascaded PQWs (30 to 10 wells) sandwiched between n ⁺ contact layers. The initial results from these devices has shown a factor of 4 improvement in emission power over the in-plane excitation devices described above. The current power level of 30 nW for these devices is comparable to the state of the art for other techniques of Terahertz generation at these frequencies.				
14. SUBJECT TERMS			15. NUMBER OF PAGES	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT	

Final
~~ANNUAL~~ TECHNICAL REPORT

AFOSR AASERT GRANT F49620-94-1-0377

**Fabrication and Properties of High-Performance Graded
Quantum Structures**

July 30, 1997

Arthur C. Gossard, Principal Investigator

Materials Department

University of California, Santa Barbara

Santa Barbara, CA 93106

19971006 160

DTIC QUALITY INSPECTED 3

I. Academic progress

The student supported under this grant, Mr. Kevin Maranowski, did not take any classes in this reporting period.

II. Technical Training

In the previous reporting period, we had started work on new far infrared (FIR) emission sources, which are based on the excitation of electrons in parabolic quantum well (PQW) resonators by passage of an electrical current parallel to a modulation-doped well.¹ The modulation-doped parabolic well samples were processed with electrical contacts and with grating couplers to allow emission of radiation from the surface of the samples. We have observed FIR emission from the PQWs using an n-InSb photoconductive detector. Since the Terahertz radiation has been observed, this device has the attractive additional possibility that, with simple modifications, it could provide a source for easily tunable emission of radiation. Such a tunable source would be unique in this portion of the electromagnetic spectrum and could have useful applications in spectroscopy, communications, and environmental monitoring.

In this reporting period, we have extended this work by creating vertical transport structures to allow for resonant injection into the higher levels of a parabolic quantum well to improve the efficiency and intensity of Terahertz emission. Initially, simple resonant tunneling diodes with a parabolic well were examined with current-voltage measurements to determine the feasibility of resonant injection in wide wells for far-infrared emission. These measurements showed the clear presence of coherence and resonant tunneling behavior for wells as wide as 1000 Å. Then, vertically injected Terahertz emission devices were made with multiple cascaded PQWs (3 to 10 wells) sandwiched between n+ contact layers. The initial results from these devices has shown a factor of 4 improvement in emission power over the in-plane excitation devices described above. The current power level of 30 nW for these devices is comparable to the state of the art for other techniques of Terahertz generation at these frequencies. Further band gap engineering of these cascaded structures is possible to improve efficiencies and output power even more.

1) "Far infrared emission from parabolically graded quantum wells", K.D. Maranowski, A.C. Gossard, K. Unterrainer, and E. Gornik, **Applied Physics Letters**, December 2, 1996, V69, N23:3522-3524.